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Attachments to Codends

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Attachments to Codends

P A M Stewart and J H B Robertson

Marine Laboratory, Aberdeen

Introduction

The codends of nets used to capture demersal fish are required by law to have a minimum mesh size. The aim of this regulation is to permit the escape of fish which are smaller than the minimum permitted size for landing. Limiting the destruction of juvenile fish is one way of conserving the stocks of the important demersal species. The capacity of a codend to release small fish depends on the meshes being open and unobstructed. Direct observation of codends with underwater television has shown that codends on nets are not simply cylinders of netting but are distorted into a bulbous shape by water pressure acting on the accumulated fish (see Plate 1). Most of the netting in front of the bulge is stretched and the meshes are closed (see Plate II). Only the meshes at the front of the bulge are open and unobstructed. It is mainly from these meshes that undersized fish escape. These comments apply to the type of codend normally used by Scottish fishermen, typically 120 meshes round with an 80mm mesh size. Present regulations do not specify a maximum number of meshes round the circumference of a codend. With a given mouth opening, increasing the number of meshes round makes their shape elongated and closed.

Fishermen attach various devices to codends to simplify handling and to reduce damage by wear and tear or by contact with obstacles on the sea bed. These devices (or attachments) are made principally of rope and sheet netting and potentially can obstruct or mask the codend meshes. Most countries with developed fishing industries have regulations describing the size and type of attachments which are deemed to cause a minimal degree of mesh obstruction. In the recently framed EEC fisheries regulations, a section is devoted to the topic of attachments to codends, defining permitted forms

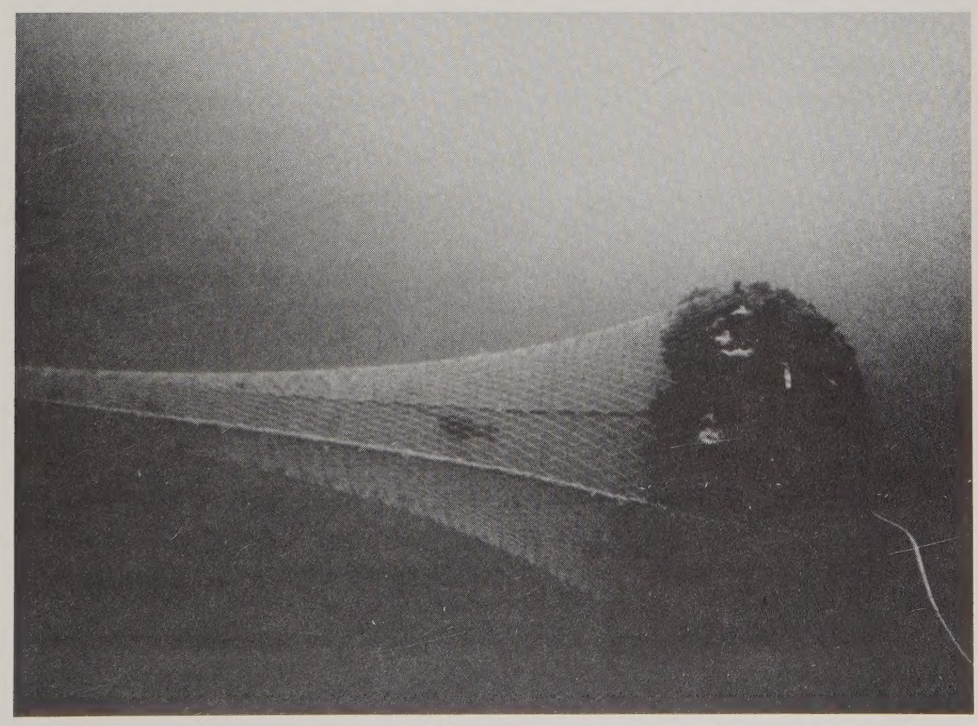

Plate I. The codend of a trawl showing the typical distended shape.

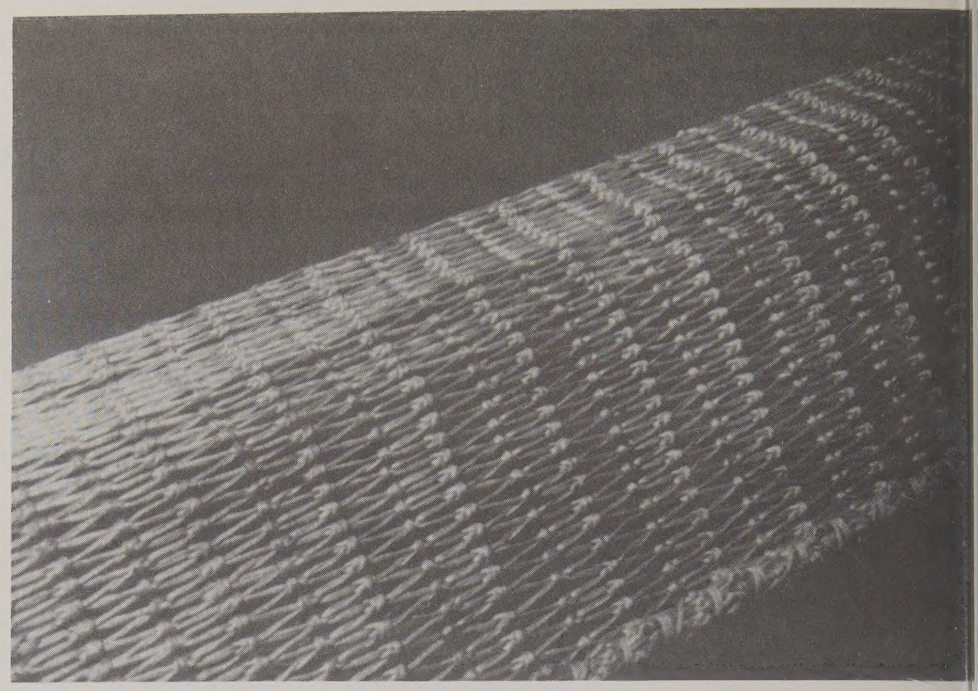

Plate II. An extension piece showing stretched and closed meshes.

of all the attachments used by fishermen in EEC member countries (Anon., 1984). During the drafting of these regulations, it was realised that few observations or measurements had been made on the obstructive effects of these devices, with the exception of topside chafers (Bohl, 1966). Such information would be of value to fisheries management and an investigation was undertaken by the Marine Laboratory, Aberdeen.

Underwater television was used to observe codends rigged with the commonly used attachments. The observations made are described in this report. Each type of attachment is dealt with in a separate section which includes an explanatory diagram where needed, construction details and photographs. An edited video film has been compiled and is available from this Laboratory. It is not the aim of this paper to present a critique of the EEC regulations. The observations were made on typical types of attachment, not those specified by the current regulations. The aim is to present information on each type of attachment which illustrates its possible obstructive effects. The attachments shown should not be considered as legally acceptable forms, as some are not permitted by existing UK regulations.

Materials and Methods

Observations were made on the attachments using a remote controlled towed vehicle on the fishery research vessel "Clupea". This vehicle was developed for making observations of fishing gears with underwater television (Wardle, 1983). Most of the work was done using the Marine Laboratory 600 hp four-panel trawl (Galbraith, 1983) or the Jackson Rockhopper 400-600 hp trawl. The latter net has a fishing circle of 462, 160mm meshes. Fishing took place off the east coast of Orkney in depths of 70 to 90m. Towing speed was around 3 knots. During each haul video-tape records were made and still photographs taken whenever possible.

The codends used had a nominal mesh size of 80mm. Most were attached to the net by an extension piece of 90mm mesh size. The codends were 75 meshes and the extension pieces 50 meshes long. Both were 120 meshes round and made from two panels of single, braided, dark green, polyethylene twine (R tex 4310). There were five gathered meshes in each selvedge. To ensure that the codend was stretched from the start of each haul, before fish

accumulated, bundles of old small mesh netting were put in to create some resistance to water flow.

Results

Observations on the various attachments are given below. The devices have different names in different parts of the United Kingdom. In this report the names are those used in the EEC regulations. Equivalents of these names may be found in Bridger *et al.* (1981).

Splitting Strap

A splitting strap or halving becket is needed to divide the catch in a codend into parts of a size convenient for lifting aboard. If the whole weight of the catch was raised at one time, the codend might tear. A typical Scottish lifting strap is shown in Plate III. The strap is a 25mm diameter polyethylene rope threaded through 75mm diameter plastic rings; these are set on the codend meshes with braided, nylon twine. There is one ring for every four meshes round the circumference. The strap is set 2m from the codline. An eye is spliced into each end and the strap circumference is 3.9m, making it 0.4 times the stretched length of the circumference. The present observations have shown that if the length ratio is at least this value, then the strap will not constrict the codend meshes in such a way as to make escape more difficult. Sometimes the ends of the strap are linked by a heavy shackle. This may pull the strap down and distort the codend.

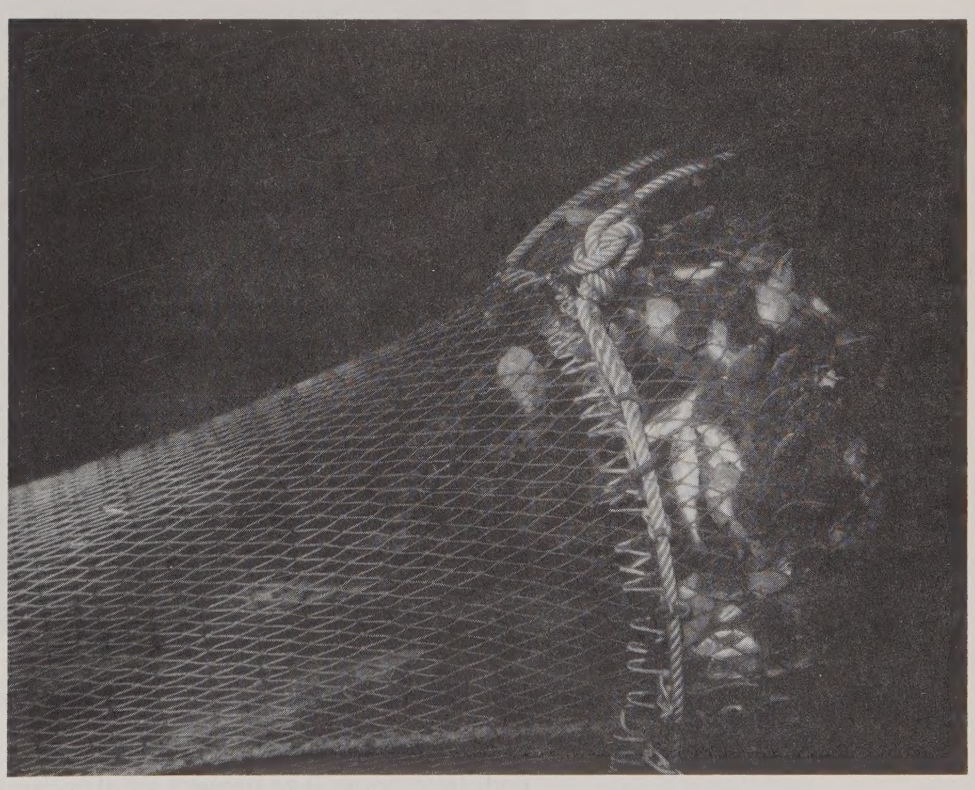

Plate III. A splitting strap on an 80mm codend.

Support rings hold the strap clear of the netting. Other means of attachment, eg. to loops on the seams, can lead to chafing, particularly if a wire strop is used. Wire strops are used on larger gears. In some countries, a strap guard or chafing piece is required to protect the codend netting. This is a piece of netting fixed to the codend beneath the lifting strap (see Fig. 1) and attached at a position where the meshes are open, allowing fish to escape. Its presence is likely to increase the mortality of undersized fish and is undesirable. Plate IV shows a 2m long, 70mm mesh strap guard which can be seen to be obstructive. Rope lifting straps set on rings appear to be

non-obstructive and preferable to straps with netting strap guards. The mesh size of a strap guard must be at least that of the codend, and the maximum permitted length is 1 m.

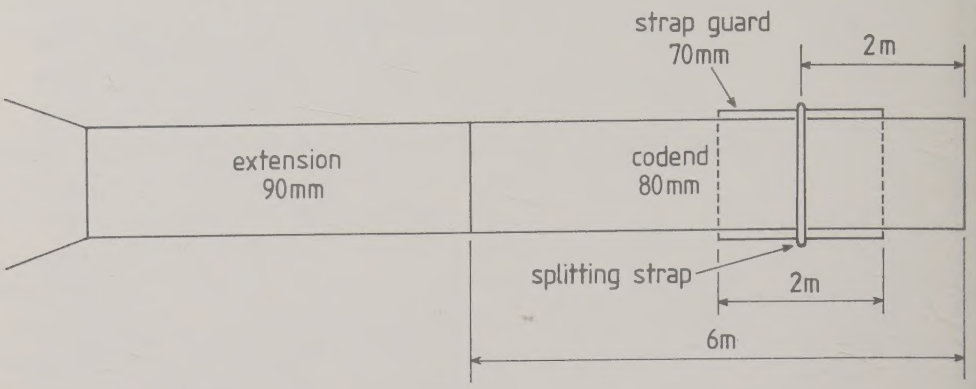

Figure 1. Strap guard and splitting strap.

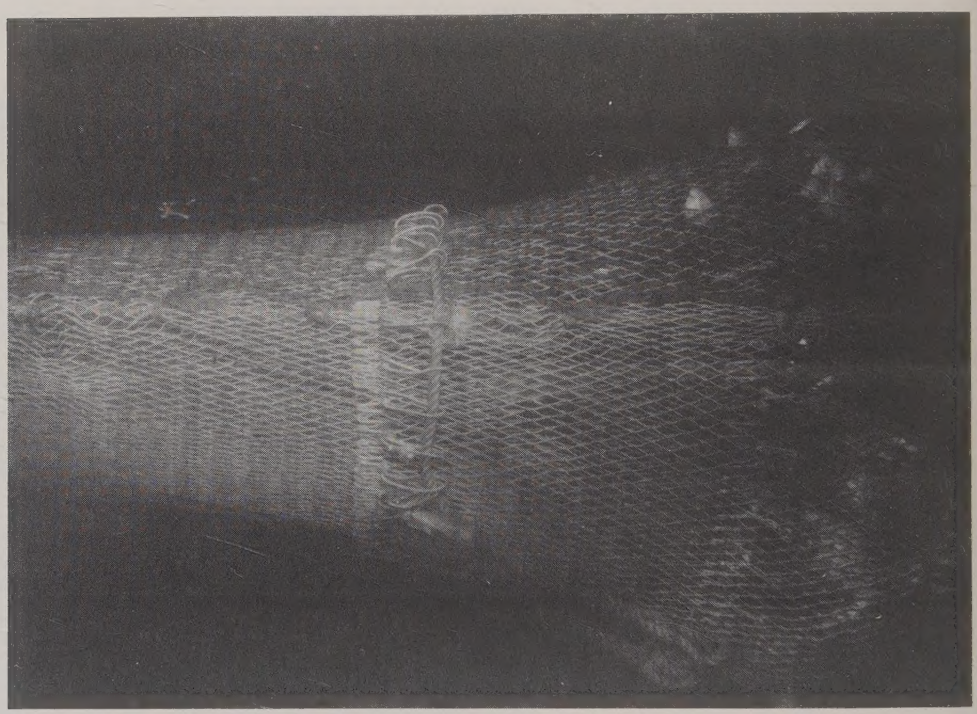

Plate IV. A splitting strap with a 70mm strap guard on an 80mm codend.

Strengthening Bag

A strengthening or lifting bag is a cylinder of netting surrounding the codend. Its purpose is to prevent a full codend from bursting when it is being lifted aboard. An appropriate length for this bag is about 2m, ie the distance from the codline to the lifting strap. A lifting bag is laced on to the codend meshes at its fore end. The aft end can be laced on to the meshes immediately ahead of the codline meshes, or the codline can be threaded through the last row of bag meshes. Several different lifting bags were put on the codend and observed: 2m and 4m in length, 80 and 160mm mesh size, tight and slack. A tight bag is one with the same stretched length and circumference as the codend it covers. Figure 2 shows the construction of a 4m long, 160mm mesh size tight bag. The slack bag was larger, by 1.33 times in circumference and 1.2 times in width in the case of the bag tested and shown here. Plates V to VII show various bags on the same 80mm codend. All the bags were 2m long and made of braided twine of the same size as that of the codend. Plate V(i) and (ii) shows a tight 160mm bag while Plate VI shows a slack 160mm bag and Plate VII a tight 80mm bag.

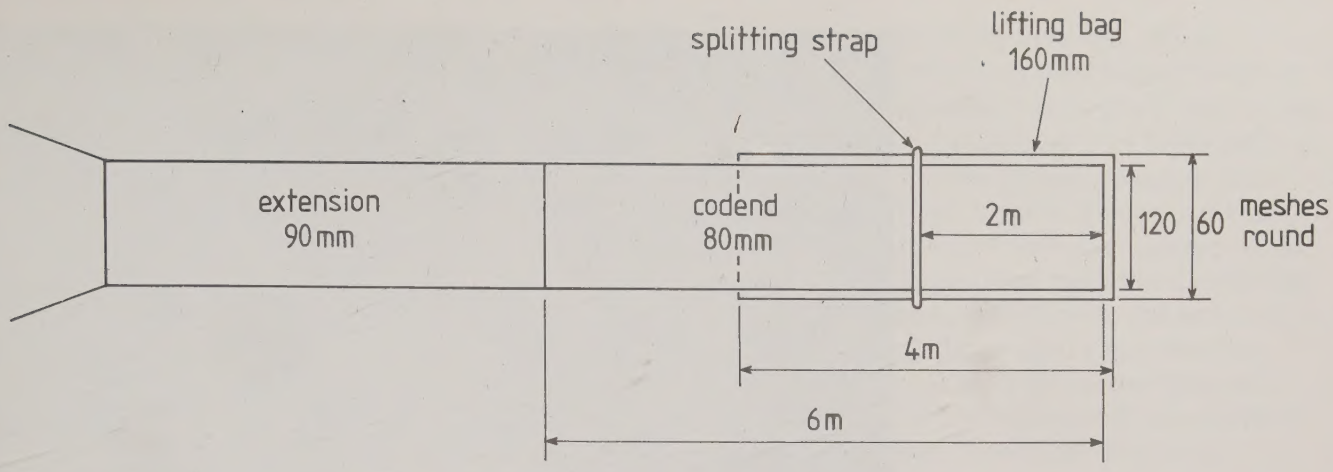

Figure 2. Four metres long, 160mm mesh size, tight lifting bag.

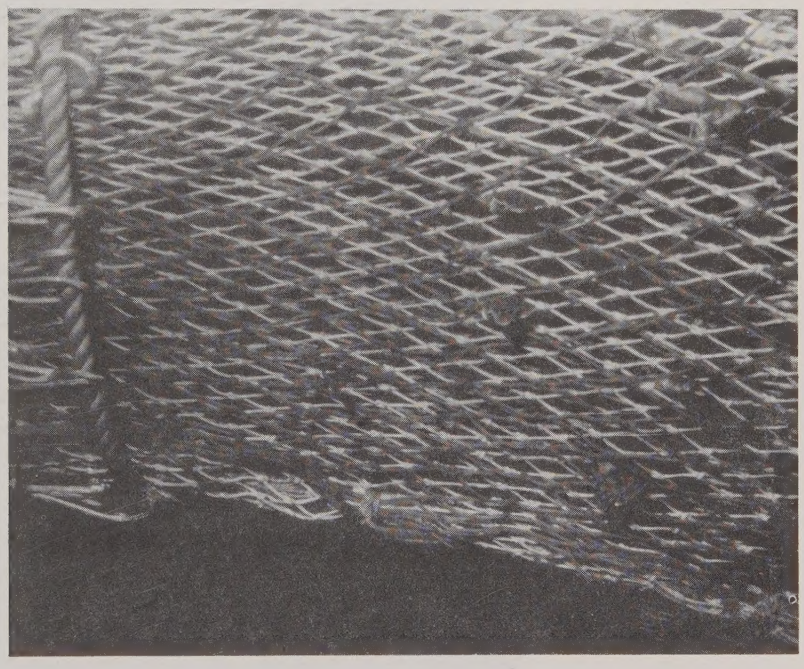

Plate V(i). A tight-fitting 160mm lifting bag on an 80mm codend.

Plate V(ii). Close-up of a tight-fitting 160mm lifting bag on an 80mm codend.

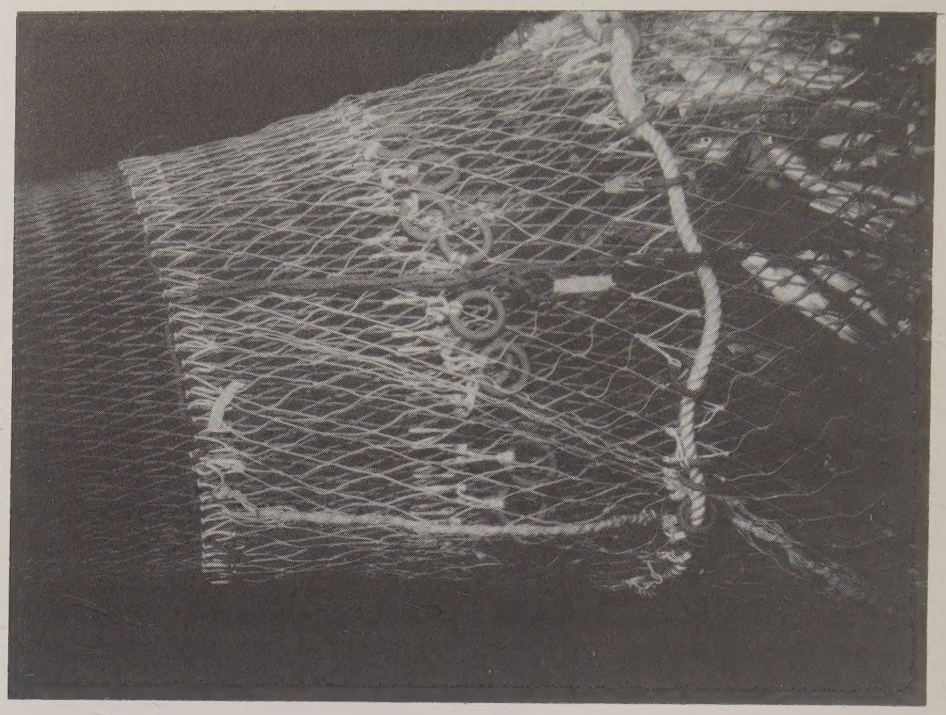

Plate VI. A slack 160mm lifting bag on an 80mm codend.

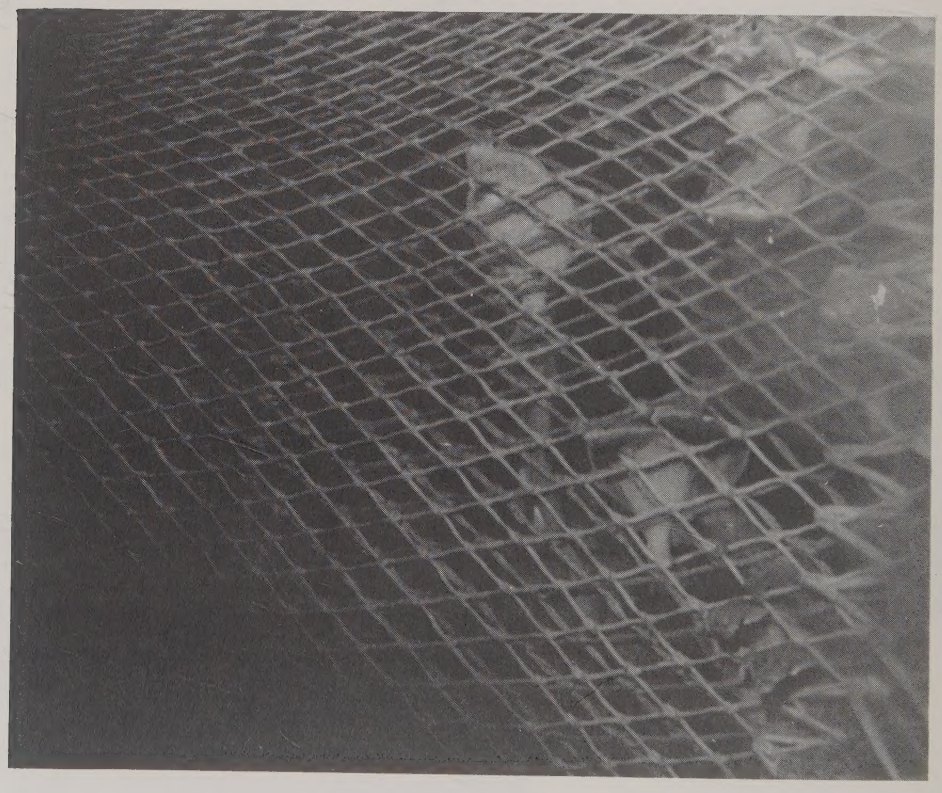

Plate VII. A tight-fitting 80mm lifting bag on an 80mm codend.

The tight 160mm bag, with twice the mesh size of the codend, appears to cause little obstruction to the codend meshes, particularly in the escape zone ahead of the bulge of captured fish (Plate V(i)). A bag made of heavier twine will be slightly more obstructive. Although the bag and codend have the same length and circumference, the bag meshes do not lie exactly on the codend meshes. It is very unlikely that this could happen with a flexible material like netting. A slack bag could be a little more obstructive in some places, simply because there is more netting present. In other areas there will be more clear space for the fish to escape. If the bag is

too slack, however, it would be little use for lifting the catch. These observations suggest that there is little merit in using slack bags. The 80mm bag can be seen in Plate VII to be very obstructive, nearly every mesh being masked. A 2m lifting bag of this mesh size is obstructive only if the catch is small enough to be confined to the last 2m of the codend. It would have only a small effect on the composition of larger catches. Since a 2m lifting bag is large enough for its stated purpose, it would seem unnecessary to use longer bags masking more meshes. Lifting bags with a mesh size double that of the codend are effective. There is no reason, therefore, to use bags with a smaller mesh size. An alternative to using a lifting bag to strengthen the codend is to construct it from double twine. This is the method generally favoured by seine net fishermen in Scotland. Lifting bags with single twine codends are preferred on trawlers, particularly those with light gear.

Chafers

Chafers are pieces of net, canvas, hide or other material attached to the top or bottom of a codend to protect it from damage by abrasion or impact on the sea bed or from damage when it is being hauled aboard. Bottom-side chafers are more common than top-side chafers but neither is common at present in Scottish fisheries. The effect of topside chafers on codend selectivity has been investigated in several countries (Holden, 1964; Bohl, 1966). There was some variation in the results obtained, but chafers 1.5 times the codend width and of the same mesh size had little effect on codend selectivity. Clark (1958) used underwater television to observe haddock escape from a codend with a topside chafer.

Bottom-side chafers of netting and canvas were observed in the present study. Plate VIII(i) and (ii) shows a bottom side chafer made of three pieces of old netting attached as shown in Figure 3. This codend was also rigged with a 160mm lifting bag. Plate IX shows a canvas bottom chafer and a net top chafer as shown in Figure 4. The bottom chafer was made of a single sheet, 3m long and 1.2m wide, fixed to the codend only at the front and sides. Both types of bottom chafer closed off the underside of the codend despite being loosely attached. However, it has been observed that fish tend to escape mainly from the upper side of a codend, so blocking off the underside should not retain many small fish.

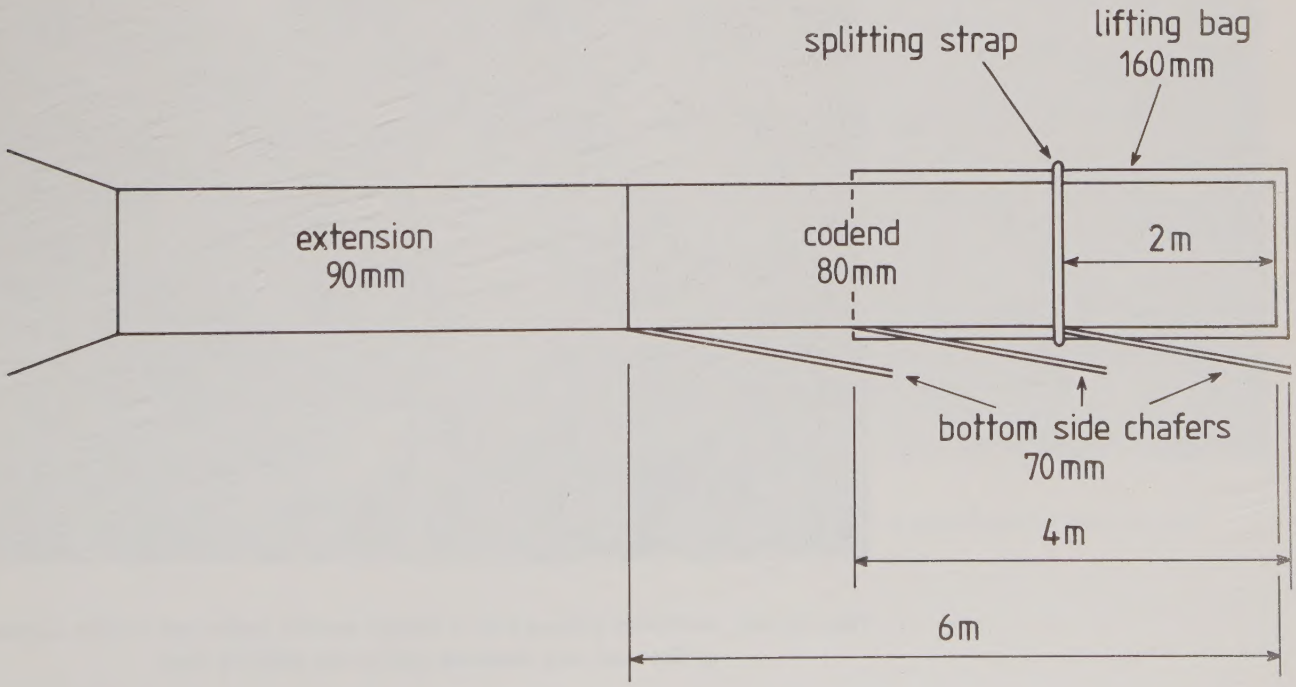

Figure 3. Netting bottom chafer, tight lifting bag and splitting strap.

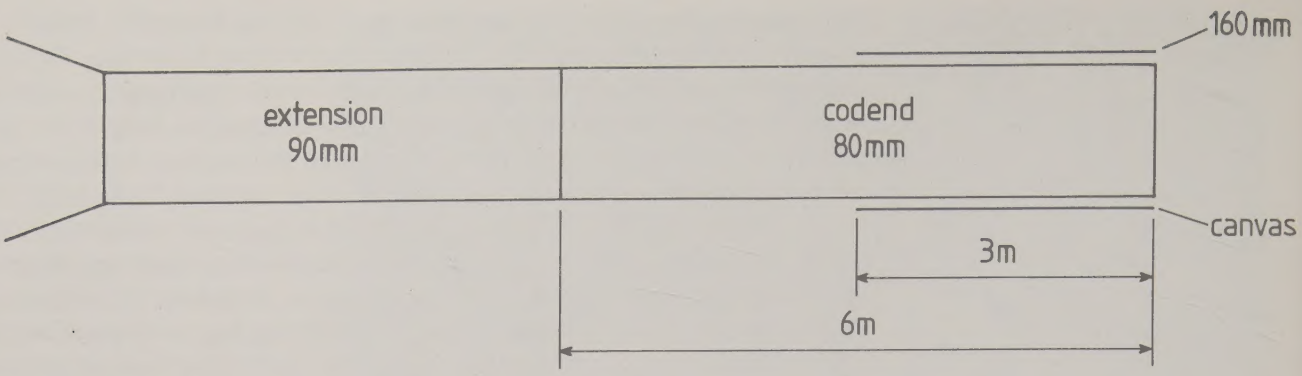

Figure 4. Topside chafer and canvas bottom chafer.

Top-side chafers are usually slackly hung sheets of large mesh netting. The top-side chafer in Plate IX was made of 160mm mesh braided polyethylene twine. It was attached 3m from the codline, had the same stretched width and had 15% more stretched length than the codend. This chafer was attached to the codend at its front and lateral edges leaving the rear edge free. In Plate IX, near the front of the chafer, the netting is very slack. Plate X gives a close-up view of a section further aft showing that the chafer is still slack.

Top-side chafers are useful if the codend twists either during towing, if it touches the bottom, or during hauling on a stern trawler, when it may tear on the ramp. During many years of making underwater observations on fishing gears, codends have seldom been seen to touch the bottom but have occasionally been seen to twist. Debris and boulders in the codend will drag it to the sea bed and the use of chafers is justified on hard ground.

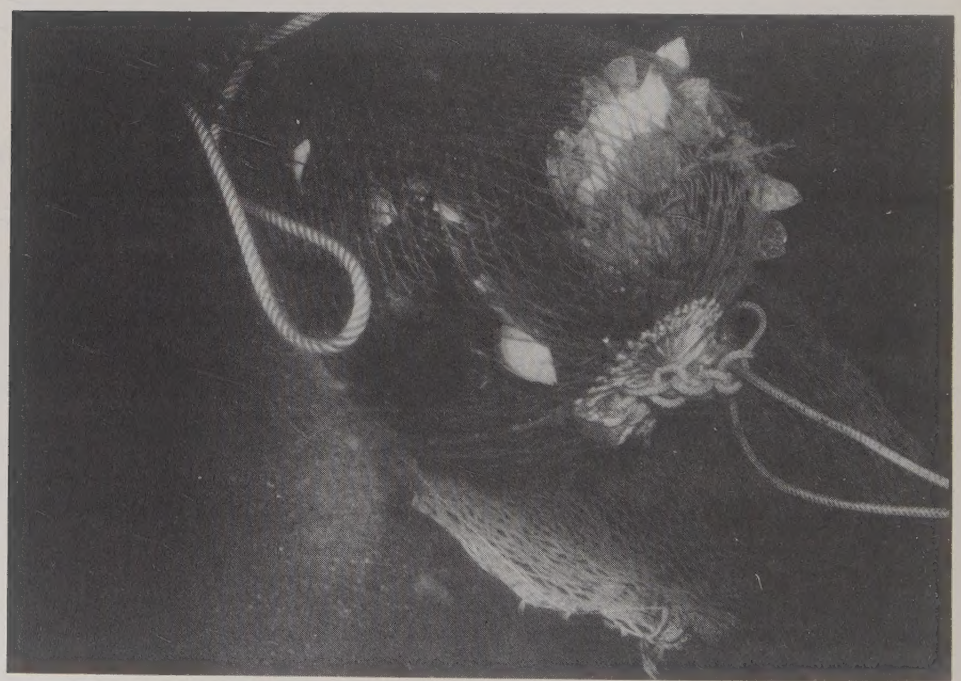

Plate VIII(i). An 80mm codend with a 160mm topside chafer and netting bottom chafer: end view, showing codline and splitting strap

Plate VIII(ii). An 80mm codend with a 160mm topside chafer and netting bottom chafer: side view.

Plate IX. Side view of an 80mm codend with a 160mm topside chafer and a canvas bottom chafer.

Plate X. Close-up of a slack 160mm topside chafer on an 80mm codend.

Two-panel trawls with low headlines of old design are more likely than trawls of modern design to tow codends close to the bottom. A codend seems to twist, especially if there is a long extension piece, when there is a large, unrestrained catch moving around in the codend and making it unbalanced. Such bulging of the codend with a large catch can be restricted by the use of strengthening ropes as described below. Cross tides may aggravate any tendency to twist. The attachment of a pair of well separated floats to each selvedge of the codend will help to avoid twisting. This has been found effective on large codends of small mesh netting. With a well designed net there seems to be little need for topside chafers.

The combination of a top-side chafer and a lifting bag is shown in Plate XI. Although the attachments are 160mm mesh size, the presence of several layers of netting was very obstructive and even small flatfish had difficulty in escaping. Multiple layers of this kind are undesirable.

The codline can be seen in Plate VIII(i). This rope is used to close the codend and is fastened with a clip or a quick-release knot. It is threaded through the final row of meshes which are usually larger and of softer twine than the codend meshes, to enable the rope to close the net tightly. The meshes around the fastening are inevitably distorted and closed. The accumulation of fish over this section of netting, however, makes escape impossible and the mesh distortion has no bearing on the selectivity of the codend.

Strengthening Ropes

A codend can be strengthened by attaching ropes lengthwise to prevent stretching or circumferentially to restrict the diameter under the pressure of accumulated fish. These ropes are called length straps and round straps, respectively. They are used mainly on pelagic trawls which can take catches large enough to burst the codend. By observing these devices on a demersal trawl codend some useful information was obtained. In the absence of a large catch, however, it was not possible to assess their limitations.

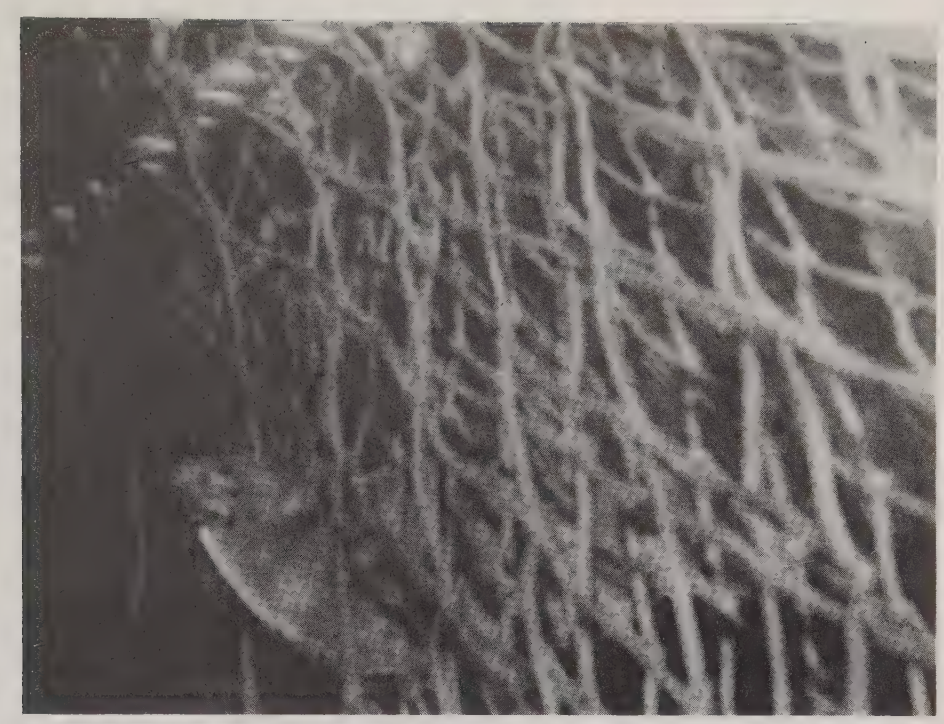

Plate XI. Close-up of a 160mm topside chafer and lifting bag on an 80mm codend.

Four length straps of 25mm diameter polyethylene rope were laced to the standard 80mm codend on its selvedges and on the centres of the top and bottom panels. The length of the straps was 6.2m, ie the same as the stretched length of the codend. Plate XII was taken looking down on the codend. It appears that the zone of open meshes has been increased slightly in extent, suggesting that the length straps are limiting the stretching of the codend. It has been observed that with shorter straps, the codend netting hangs in slack folds.

Plate XII. Length straps on an 80mm codend.

Four round straps of the same type of rope were rigged on an identical codend using plastic rings as described above for the splitting strap. The rope lengths were set at 3.2, 3.6, 4.0 and 4.8m, respectively, from the front. Plate XIII shows the 4.8m long round strap and the splitting strap. The codend is the normal bulbous shape and its diameter at the round straps is much less than their set length. They have no effect on the codend shape but, with a large catch, the codend could swell out until restrained by the round straps.

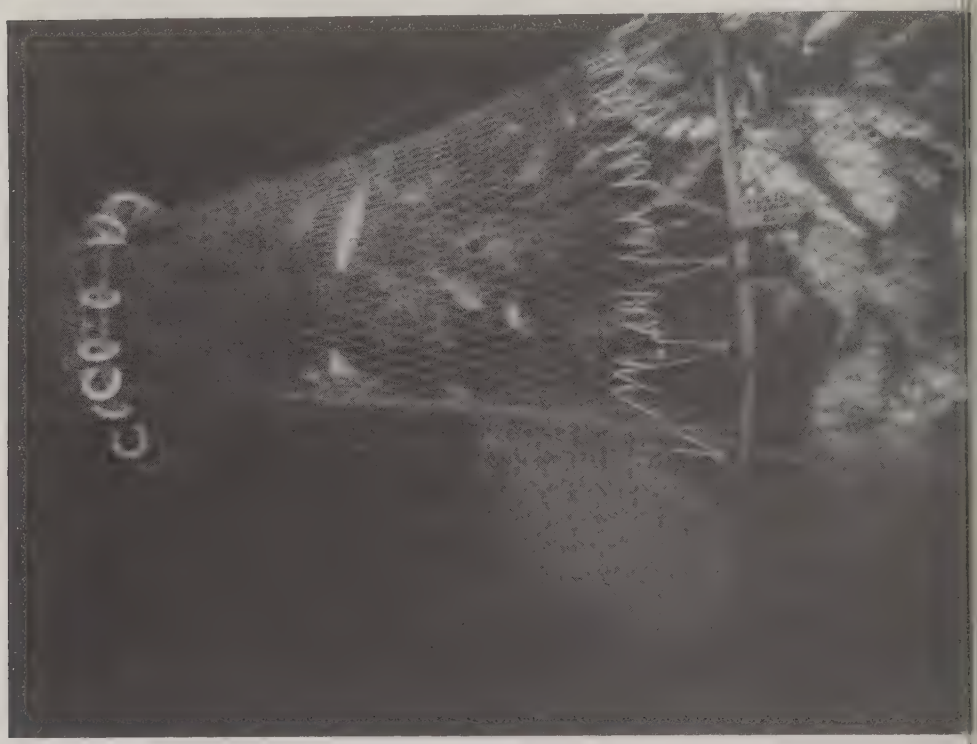

Plate XIII. Round straps on an 80mm codend.

Flappers

Flappers are pieces of slack netting hung in the mouth of the codend or the extension piece to act as "non-return" valves. They are normally of lighter twine than the codend. When the towing vessel slows down to haul, it is thought that the flapper collapses and blocks the codend. No direct observations have been made of flappers during hauling to confirm that this happens. Two types of flapper were examined: a Scottish style flapper and a conical flapper. Both types are illustrated in Figure 5. A Scottish style flapper is a single, tapered sheet of netting laced at the front edge around the top panel of the codend and at the sides to the selvedges and along the bottom panel. The rear edge is left free. The conical flapper is a truncated cone of netting with the wide end attached around the codend circumference.

Photographs were obtained of 80mm mesh size flappers of both types mounted in the front of a codend. The Scottish style flapper shown in Plate XIV(i) was 138 meshes wide at the front and 45 meshes long. The first seven meshes from the front were not tapered but thereafter the sheet was tapered down to a width of 62 meshes. The conical flapper in Plate XIV(ii) was made of two panels, each 100 meshes wide at the front, 32 meshes wide at the rear and 35 meshes long. At the towing speed of approximately 3 knots, the water pressure pushed the netting in both flappers out close to the codend netting. This kept the codend clear and allowed fish to pass along it freely. Thus, although the flappers were tapered, the netting was still sufficiently slack to stretch out to the full width of the codend.

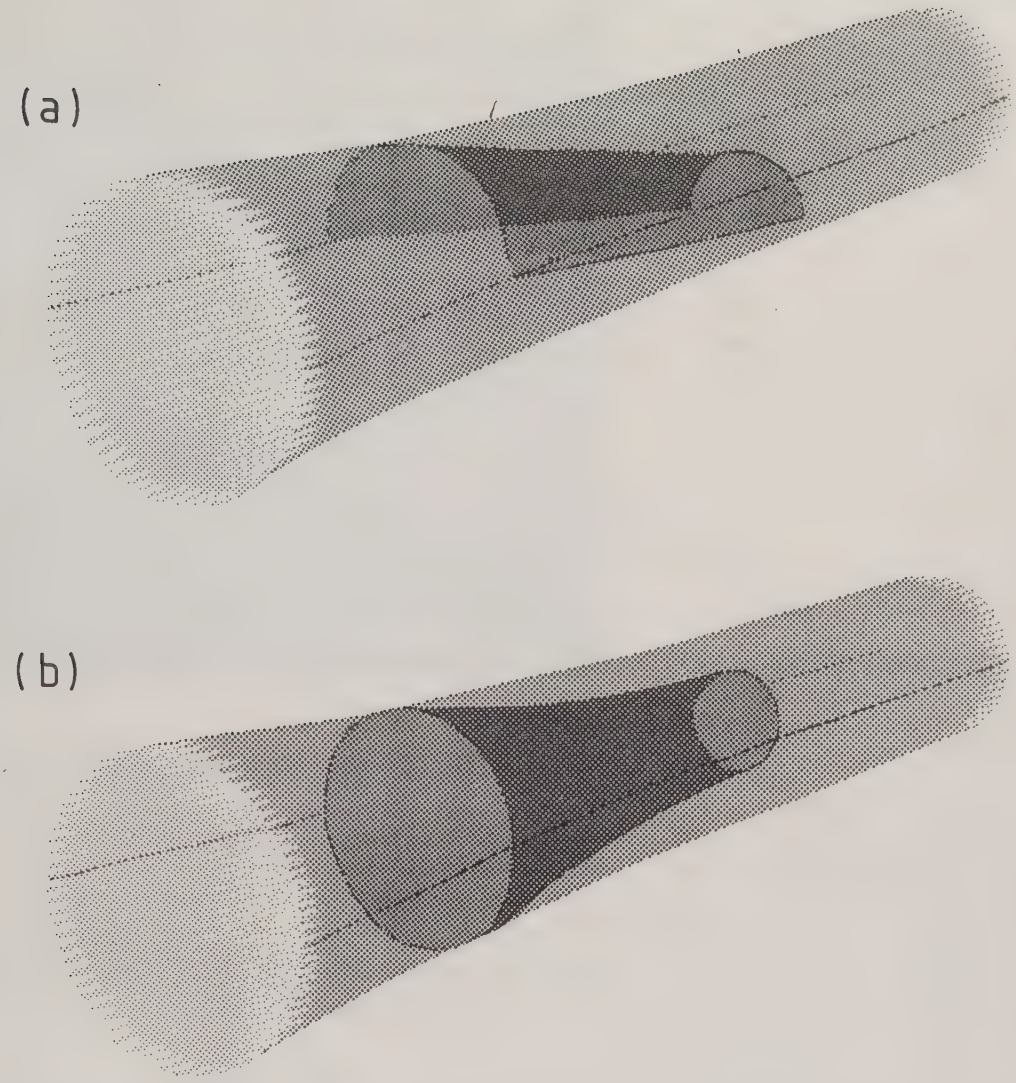

Figure 5. (a) Scottish style flapper; (b) conical flapper.

Plate XIV(i) A Scottish style flapper mounted in a codend.

Plate XIV(ii). A conical flapper mounted in a codend.

There is a danger of fish becoming meshed in flappers. To prevent this, flappers could be made of smaller mesh netting than the codend (possibly 50mm or less). Flappers of the type shown here, mounted in the front of the extension piece, would not interfere with fish escape and could be made of small mesh netting. However, the present regulations require flappers to have a mesh size at least equal to that of the codend.

Summary

The various devices attached to codends to simplify handling, minimize damage and improve efficiency include lifting bags, splitting straps, chafers, strengthening ropes and flappers. By constricting the codend and blocking the meshes such devices may prevent the escape of undersized fish. To investigate this possibility the devices were rigged on codends and observed with underwater television. The observations are reported and illustrated by photographs showing the effect of the attachments on codend shape and mesh opening.

Acknowledgements

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